APPLICATION

FOR

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FOR

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FOR

LIGHTED GARMENTS, FOOTWEAR, BACKPACKS, AND OTHER ACCESSORIES WITH IMPROVED SWITCH

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BACKGROUND OF THE INVENTION

The present invention relates to garments, footwear, backpacks, and other accessories worn with lighting elements. Garments and footwear with flashing lights have been popular for a number of reasons, including safety, an attractive appearance and simply for a novelty effect.

Lighting units for clothing and footwear have typically included a light source, such as one or more light-emitting diodes, a power source, such as a battery and a switch to cause the power source to be connected to the light or lights. Often such units will include electronic circuits which can control the time such lights are actually illuminated, which limits the power consumption, saving the battery. Short-term flashing often makes the display more visible, adding to the safety provided by the units. It also makes a more attractive eye-catching display.

A number of different types of lighting units or circuits have been described in the prior art. U.S. Patent 4,158,922 to Dana III includes a mercury switch that responds to movements of the foot to turn a light on and off. A mercury switch operated system is also taught in U.S. Patent 4,848,009 to Rogers.

Various arrangements have been developed for minimizing battery drain. Applicant's earlier U.S. Patent 5,477,435 issued December 19, 1995, now RE 37,220E, shows a light module with an LED having one terminal in contact with one side of a wafer battery, and the other terminal spaced away from the battery but including a weight which will cause the upper terminal to move by inertia in response to a shoe striking a surface to contact the battery to illuminate the LED. In this way, the LED is

not illuminated and does not draw power from the battery when the module is at rest. Other modules for illuminating lights in footwear are shown in U.S. patents 5,408,764 and 5,932,975. U.S. Patent 5,932,975 also includes microcircuits with a photosensitive switch to cause illumination to fade and then shut off entirely with full daylight. This is one of a number of battery-saving arrangements in the art.

One kind of switch in common usage is a spring switch which consists of an elongated coil of wire which has one end connected to one terminal in an electrical circuit and the opposite end cantilevered over a second terminal in the circuit. With the impact of the footwear against a surface or movement of body members carrying the switch, the spring will tend to bounce against the second terminal a number of times, thereby producing a series of positive or negative going electrical spikes or pulses.

Another type of switch which has been used in the above-described application is similar to a mercury switch but using a ball bearing which moves from an at-rest position where no contact is made with a second terminal to a position where the ball provides contact across two terminals, thereby closing a lighting circuit.

An objection which has been made to the systems described above is that once the illumination begins, it is quite regular and predictable during the period when illumination is taking place. It is believed that the desired effect would be considerably enhanced if the illumination were to be a more accurate light display of the shoe or garment movement rather than the distorted display produced by the spring-type switch trigger.

Mercury switches are currently considered unacceptable because of the toxic nature of mercury.

It is therefore an object of the present invention to provide a switch for use with lighting systems for footwear and other clothing which provides a more accurate display rather than the controlled output of switches presently in use.

Another factor that is of considerable importance in this application, especially with children's shoes, is cost. The switch constitutes a significant part of the cost of such lighting systems, and it would be very desirable to reduce such cost. It is, therefore, another object of the present invention to provide a switch suitable for use with shoes or clothing illumination systems which is significantly less expensive than those presently in use.

One further need is to provide a simple, low-cost switch that is not subject to inadvertent closed condition when the footwear or clothing happens to be in any random orientation as on a closet floor. This result has been achieved by employing switching logic in the module. This is the result of the use of a logic circuitry which responds to a switch closure to initiate one sequence of several pulses but will not continue sequencing until the switch opens and then recloses. This simplifies the switch design so that a closed contact condition only produces one sequence and then stops until the switch opens and recloses. No guards are required for preventing a closed switch condition to drain the battery.

BRIEF SUMMARY OF THE INVENTION

The switch which applicant has devised for use in lighting systems for wearing apparel, including shoes, jackets, backpacks, and the like, is small and incorporated into a very simplified electrical circuit which provides output signals to one or more light sources, such as lamps or LEDs. The switch itself includes a tubular housing of insulating material, such as glass, plastic or PVC (polyvinyl chloride) tubing. Preferred cross sections of the housing may be circular, triangular, or rectangular (square). Other cross-sectional shapes, such as oval, may be used. A pair of longitudinally spaced contact pins extend into the housing leaving terminals on the outside which are connected into the circuit and conductive points inside the housing.

A free-floating bar of conductive material is carried inside the housing, spaced from the contact pins. The length of the bar is sufficient to span the contact pins so that, upon movement of the switch, the bar will tend to instantaneously bridge the contact pins, thereby sending an input signal to the circuit and causing the LEDs or other light source to be illuminated. Unlike the spring switch described above, which inherently provides a series of input pulses for each movement of a shoe, for example, the switch described above only provides one input pulse per bridging contact between the contact pins. There may be several such bridging contacts, but these can be quite instant on and off in response to such movement.

Since there is a possibility that the shoe or other clothing could be tossed into a closet or other location into a position where the bar remains bridged across the contact pins, the contact pins may have insulated sidewalls so that contact of the bar with the

contact pins is limited to desired areas of the pin surface.

This result can also be obtained by employing switching logic in the module. This is the result of the use of a logic circuitry which responds to a switch closure to initiate one sequence of several pulses but will not continue sequencing until the switch opens and then recloses. This simplifies the switch design so that a closed contact condition only produces one sequence and then stops until the switch opens and recloses. No insulation on the contact pins is required for preventing a closed switch condition from draining the battery.

To retain the free-floating bar, end members are either attached to the housing or formed in the housing. By using the free-floating bar, both the spring and spring mount are eliminated, which adds to reliability, while also reducing size and cost.

In addition to the above features, the size and weight of the free-floating bar and housing cavity can be modified to vary switching characteristics and sensitivity of the switch. The switch characteristics, particularly response time, may be modified by placing a non-conductive liquid in the housing.

BRIEF DESCRIPTION OF THE DRAWINGS

This invention may be more clearly understood with the following detailed description and by reference to the drawings in which:

Fig. 1 is a perspective view of a shoe, shown in phantom, with a lighting system including a switch according to the invention;

Fig. 2 is a side elevational view of the shoe of Fig. 1;

Fig. 3 is an enlarged side view of the lighting system shown in Figs. 1 and 2;

Fig. 4 is a plan view, partly in phantom, of a substantial part of the lighting system of Figs. 1-3;

Fig. 5 is a sectional view taken along line 5-5 of Fig. 4;

Fig. 6 is a sectional view taken along line 6-6 of Fig. 5;

Fig. 7 is a perspective view, with a portion broken away, of an alternative embodiment of the switch shown in Figs. 4-6;

Fig. 8 is a front view of an individual wearing a shirt or jacket, including flexible lighting strips and employing the switch of this invention;

Fig. 9 is an enlarged fragmentary view of the encircled portion of Fig. 8 designated with numeral 9;

Fig. 10 is a schematic drawing of an electrical lighting circuit usable with the lighted shoe of Figs. 1 and 2 or the flexible lighting strips of Fig. 8;

Fig. 11 is a more detailed schematic of the system of Fig. 10;

Fig. 12 is a perspective view of another embodiment of the switch of the invention;

Fig. 13 is a longitudinal sectional view of the switch of Fig. 12;

Fig. 14 is a perspective view of a still further embodiment of the switch of the invention;

Fig. 15 is a sectional view taken along line 15-15 of Fig. 14;

Fig. 16 is a sectional view taken along line 16-16 of Fig. 14; and

Fig. 17 is a rear view of an individual wearing a backpack including flexible lighting strips similar to those of Fig. 8 and employing the switch of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to Fig. 1, a shoe **10** is shown having an electrical circuit board **12**, including a battery **14** and a switch **16** embedded into its heel. Connected to the electrical circuit board **12** are pairs of wires **18**, **20**, and **22** terminating in light sources, such as LEDs **24**, **26**, and **27**, respectively, which are located on or in the shoe **10** such that they are readily visible and will attract attention of those nearby.

Fig. 2 is a side elevational view of the shoe **10** of Fig. 1 showing the circuit board **12**, the battery **14**, switch **16**, wires **18** to LED **24**, and wires **20** to LED **26**.

Fig. 3 is an enlarged side elevational view of the electrical circuit board **12**, which is secured to the battery **14**. Switch **16** of this invention is secured to the circuit board **12** and includes a contact bar **36**, contact pins **28** and **30** secured to wires **32** and **34**, respectively, connected to circuit board **12** (see Fig. 4). Only contact pin **28** and wire **32** are visible in this view. Also connected to circuit board **12** are wires **18**, **20**, and **22** connected to LEDs **24**, **26**, and **27**, respectively.

Fig. 4 is a plan view of the circuit board **12** and switch **16**. Since battery **14** is actually under circuit board **12**, it is not visible in this view and is shown in phantom. Wires **18**, **20**, and **22** are shown in fragmentary form connected to circuit board **12**. Contact pins **28** and **30** are shown connected to circuit board **12** by means of wires **32** and **34**. Shown in phantom within switch **16** is contact bar **36**, discussed below and better disclosed in Figs. 5 and 6.

Fig. 5 is a sectional view taken along line 5-5 of Fig. 4. This view shows the structure of switch **16**, including a housing **38**, which may be of glass or other insulating

material, such as plastic or PVC tubing. Embedded in the sidewall of housing **38** are contact pins **28** and **30**, which are longitudinally aligned. Freely movable within housing **38** is a contact bar **36** of electrical conducting material which is of sufficient length to bridge contact pins **28** and **30**, even if one end of contact bar **36** is against one of end walls **39** of housing **38**. While end walls **39** are shown as separate plug members, any suitable closures for the ends of housing **38** can be used. With movement of switch **16**, contact bar **36** will move to the position shown in dashed outline where it momentarily closes a connection between contact pins **28** and **30**.

Fig. 6 is an enlarged sectional view taken along line 6-6 of Fig. 5. This view shows a hollow, cylindrical housing **38** with contact pin **28** through its sidewall and contact bar **36** resting on the bottom of the housing. A view of contact bar **36** in dashed outline depicts the alternate position of contact bar **36** contacting contact pins **28** and **30** following movement of switch **16**. Pins **28** and **30** may each have an insulating coating on the pin portion or insulating collars **29** to prevent the contact bar **36** from lodging above the pin heads **28H** and **30H**.

Fig. 7 is a perspective view of an alternate embodiment **16a** of the switch of Figs. 1-6. In this embodiment, the housing **40** has a square cross section and is arranged in a diamond-like configuration with contact bar **42** sitting in a V-shaped groove at the bottom of the housing. A portion of the end of housing **40** is broken away to show contact bar **42** in housing **40**. As in the case of switch **16**, bar **42** will tend to move upwardly in case switch **16A** is moved and make contact with contact pins **44** and **46**. The tubular housing of switch **16** could be of other cross sections, such as oval, so long as the sidewalls do not interfere with movement of the contact bar toward and away

from the contact pins.

Fig. 8 is a front view of an individual **48** wearing an article of wearing apparel, specifically a shirt or jacket **50** having light-transmitting strips **52** and **54**, preferably of plasticized polyvinyl chloride (PVC), secured to its sleeves. Details of this garment and lighting strips are described in greater detail in U.S. Patent 5,649,755 of this inventor. Light-transmitting strips **52** and **54** are illuminated by lamps or LEDs connected to a circuit board **12** or a similar board, including a switch **16** or a switch **16A**, as shown in Figs. 1-6 and 7, respectively. Upon movement of the individual wearing the shirt of jacket **50**, the contact bar **36** or **42** (Fig. 5 or Fig. 7) will close the circuit on circuit board **12** causing illumination of the lamps or LEDs **60** and **62** (Fig. 9), which causes light to travel through strips **52** and **54**.

Fig. 9 is an enlarged view of the encircled portion **9** of Fig. 8. The sleeve of jacket **50** includes light-transmitting strips **52** and **54** ends of which are in close proximity to LEDs **60** and **62**. LEDs **60** and **62** are connected to circuit board **12** such that movement of the individual **48**, and particularly of his arms, will cause momentary closure of switch **16** resulting in illuminating of LEDs **60** and **62**. This momentary illumination of the LEDs will cause light-transmitting strips **52** and **54** to be illuminated also. An identical arrangement will illuminate strips similar to strips **52** and **54** on the surface of a backpack. Articles of clothing referred to herein are deemed to include backpacks wherein such illumination will provide a particularly effective safety measure. Other such indirect lighting arrangements may include fiber optic strands which pick up light from LEDs and transmit it wherever desired.

Fig. 10 is a schematic drawing of the electrical system of Figs. 1-4. Switch **16** is

shown including contact pins **28** and **30** and contact bar **36**. Contact pins **28** and **30** are connected through bar **36** whenever it bounces upward and makes contact with both such pins. A battery **14** is connected to a counter circuit **56**, which could be a CD4516 cmos counter and which responds to a signal from switch **16** by sending an input signal to an LED flasher unit **58** which drives LEDs or lamps **24**, **26**, and **27**. Battery **14** is also connected to flasher unit **58**. Counter circuit **56** or an additional counter may include means responsive to initiation of a lighting signal for counting a given period and then disconnecting power to flasher unit **58**. In this way, the battery **14** is protected from unwanted power drain in the event shoe **10** or jacket **50** happens to be left in a position in which contact bar **36** or **42** bridges contact pins **28** and **30** or contact pins **44** and **46**.

Fig. 11 is a somewhat more detailed schematic drawing of the electrical system of Fig. 10. Output signal from switch **16** appears at terminal **15** of cmos counter **56** (CD4516) and also at terminal 2 of the timer **57** (7555). Counter **56** provides output pulses to an LED flasher unit **58** which drives lamps or LEDs **24**, **26**, and **27**. The input signal from switch **16** causes timer **57** to begin counting for a given period after which it sends a reset pulse from its terminal 3 to input terminal 1 of flasher unit **58**, which resets counter **56** to a zero output state, thereby causing the LEDs to stop flashing.

The preferred embodiment of the invention employs:

Cmos synchronous programmable 4-bit counter of Texas Instruments Type CD4516;

Cmos presettable up/down counter Type 74C160 of Texas Instruments;

National Semiconductor Timer Type LM555/LM555C timer;

Type T-1¾ LEDs of Kingbright Electric Co.

3V lithium battery, Type CR-2032.

It will be recognized that the described system may be varied in a number of ways. In particular, the number and arrangement of light sources on or around a shoe could involve either more or less than three light sources. All the light sources may be on the shoe or some may be elsewhere on the wearer's clothing.

This unit not only provides a selectable flashing rate by circuit component selection but also responds to a switch closure to provide one pulse sequence but does not run continuously. The switch must open and reclose to start each flashing sequence. This prevents battery drain if the switch remains closed indefinitely.

Figs. 12 and 13 show another embodiment of my switch **16b** in which the housing could be made of PVC material or other plastic. This switch **16b** incorporates a cylindrical plastic housing **68** having metal contact members **70** formed around its ends. The housing **68** is closed at its ends with plugs **71**. Contact members **70** include interior contacts **72**, which interact with free moving bar **36** and exterior contacts **74**. Contacts **74** connect with counter circuit **56** as described above.

Fig. 14 is a perspective view of an alternate embodiment of the switch of Figs. 1-6. In this embodiment, the housing **78** is generally cylindrical with contact pins **80** and **82** extending through the bottom of the sidewall of the housing. Contact pins **80** and **82** are connected to circuit board **12** by means of wires **84** and **86**. Contact bar **90**, which is of electrical conducting material, is freely movable within housing **78** and is of sufficient length to bridge contact pins **80** and **82**. With movement, contact bar **90** will move to the position shown where it momentarily closes a connection between contact pins **80** and **82**. This alternate embodiment is significantly more sensitive than that

shown in Figs. 1-6.

Fig. 15 is a sectional view taken along line 15-15 of Fig. 14. This view shows the housing **78** with one embedded contact pin **82** visible. Contact bar **90**, which is of sufficient length to bridge the longitudinally aligned contact pins, is freely movable in housing **78**. While at rest, contact bar **90** is closing the connection between the contact pins **80** and **82**.

Because of the action of the counter circuit **56** discussed above in relation to Figs. 10 and 11, an initial contact of bar **90** with pins **80** and **82** will start counter circuit **56** counting for a given time or number of cycles energizing LEDs **24**, **26**, and **27**. After the given time or number of cycles has passed, counter circuit shuts off, the LEDs stop flashing, and there is no more drain on the battery.

Fig. 16 is a sectional view taken along line 16-16 of Fig. 14.

Fig. 17 is a rear view of an individual **100** carrying a backpack **102**. Secured to backpack **102** are flexible lighting strips **52'** and **54'** which are, or may be, similar or identical to lighting strips **52** and **54** of Fig. 8. Lighting strips **52'** and **54'** are illuminated by lamps connected to a circuit such as that shown in Figs. 1-6 and 7 and possibly including the circuit of Fig. 11 or a similar circuit. Movement of individual **100** results in closing the circuit on circuit board **12**, causing illumination of lamps or LEDs **60** and **62** resulting in lighting strips **52'** and **54'**.

Advantages of the above switch are:

1. Provides momentary contact resulting in instant lighting effects rather than a set pattern of flashes.

2. Is more reliable than other switches used in systems for illuminating

shoes, etc.

3. Lower in cost because of fewer parts, no springs, and no precision positioning of parts, or adjustment during manufacture.

4. In combination with the above-described electrical system, it avoids unintended battery drain by switch closures due to position of switch when the garment is not being worn.

The above-described embodiments of the present invention are merely descriptive of its principles and are not to be considered limiting. The scope of the present invention instead shall be determined from the scope of the following claims including their equivalents.